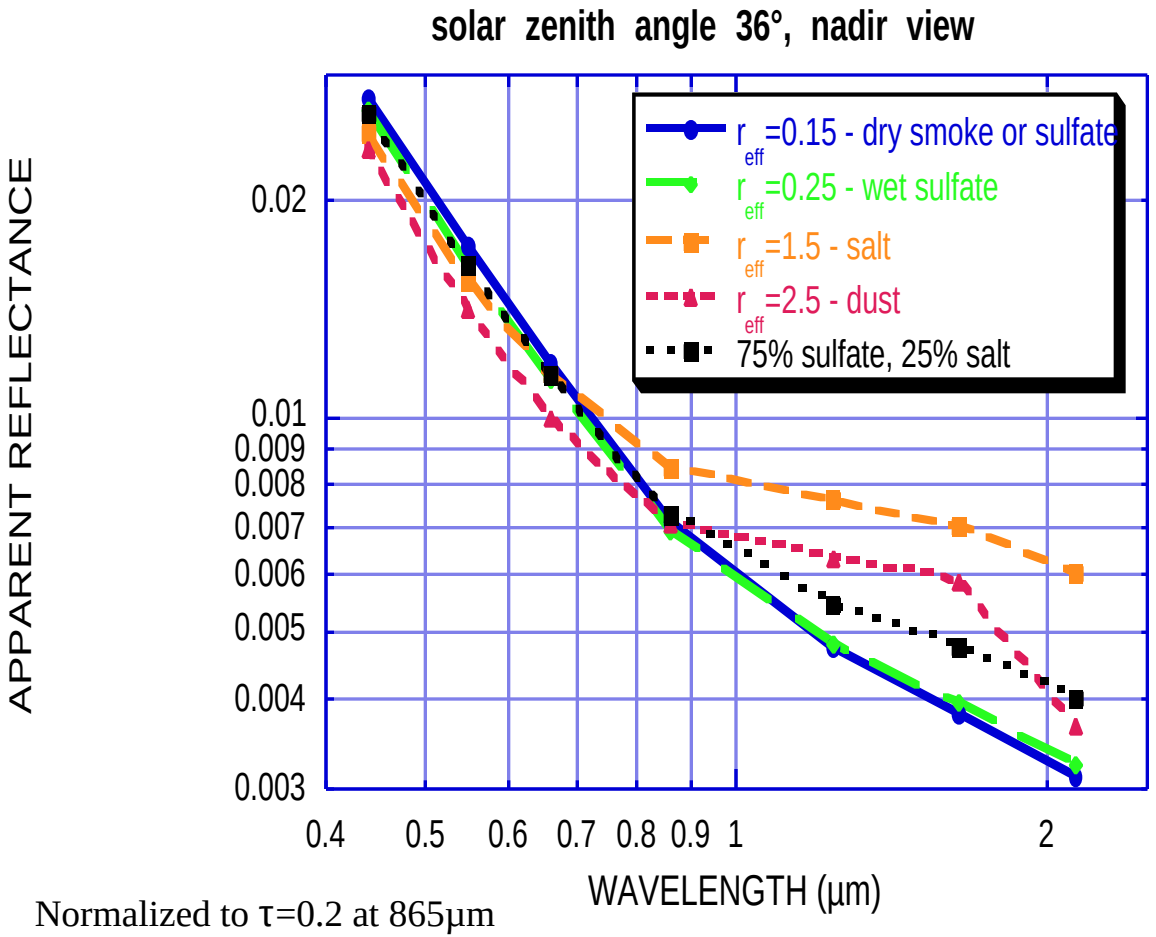
Aerosol Retrieval Algorithms: Based on the spectral information

$\rho^{toa}_{\lambda} \sim \rho^{atm}_{\lambda} + \rho^{surf}_{\lambda}$ (443-2130nm).

- Over ocean, ρ^{surf}_{λ} is known (550-2130nm)
  - $\rho^{atm}_{\lambda} \sim \tau_{\lambda} * P_{\lambda}(\theta)$; the spectral information is large enough for getting information on aerosol type and then the aerosol content is derived.

- Over land, ρ^{surf}_{λ} is unknown
  - if $\rho^{atm}_{\lambda=2.1} \sim 0$, then $\rho^{surf}_{\lambda=2.1}$ can be obtained
  - $\rho^{surf}_{\lambda} \sim f(\rho^{surf}_{\lambda=2.1})$ then ρ^{atm}_{λ} can be derived
  - τ_{λ} can be derived assuming an aerosol model, i.e $P_{\lambda}(\theta)$; if there are relationships for more than one wavelength, the aerosol model can be also adjusted.

Ocean Algorithm Description (1/2): Principle



Normalized to τ=0.2 at 865µm

- Radiance data in 6 bands (550-2130nm).
- Spectral radiances (LUT) to derive the aerosol size distribution
- Radiance at 865µm to derive τ
- Two modes (accumulation 0.10-0.25µm; coarse1.0-2.5µm); ratio is a free parameter

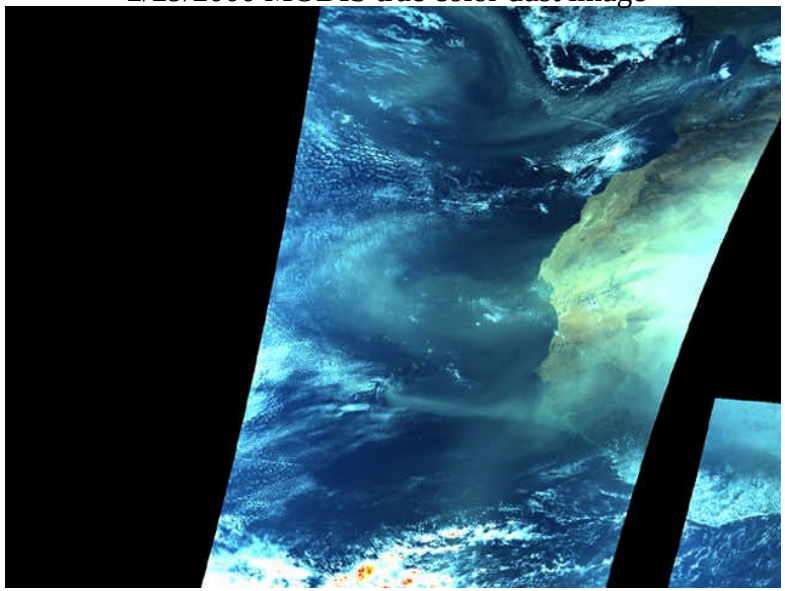
Ocean Algorithm Description (2/2):

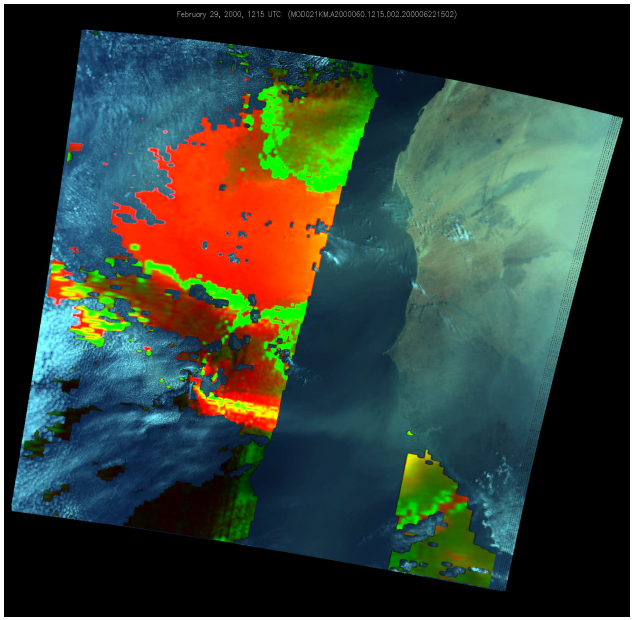
- Ocean product (10kmx10km):
  - Total Spectral Optical thickness
  - Effective radius
  - Optical thickness of small & large modes/ratio between the 2 modes

- $\Delta\tau \sim \pm 0.03 \pm 0.05\tau$ (dust excepted)

February 29, 2000: Dust over the ocean

2/29/2000 MODIS true color dust image





Red: Large dust particles Green: Small particles

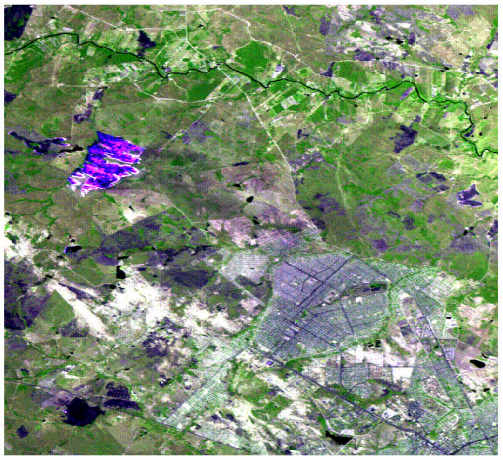
Land Algorithm Description (1/3) : Principle

Using the spectral information to sense aerosol over the land

ER-2, AVIRIS spectral image from SCAR-B of smoke over Cuiaba on Aug. 25, 1995

RGB: 0.47 µm, 0.55 µm, 0.66 µm

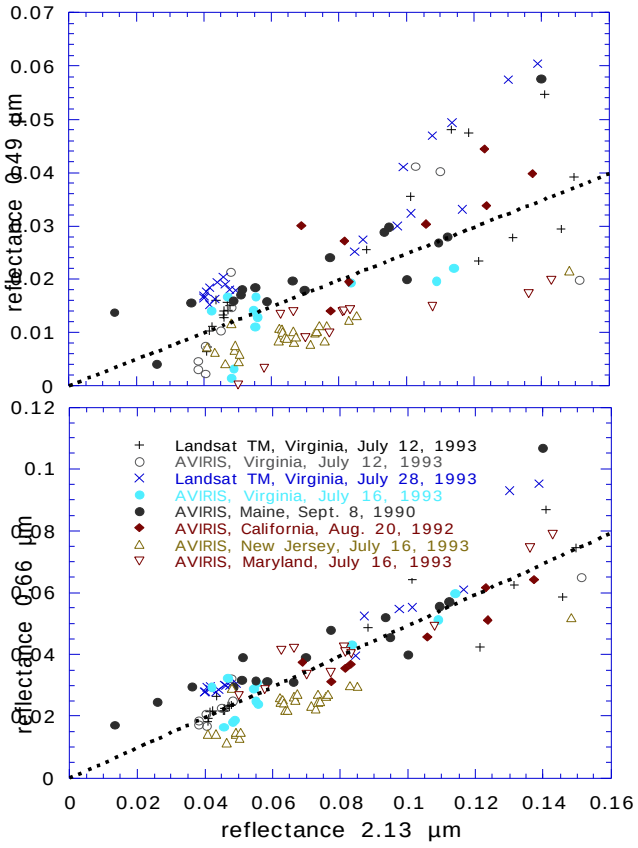
Heavy smoke. The image resembles human vision.



Near-IR RGB: 2.1 µm, 1.2 µm, 1.65 µm

The smoke is almost transparent in the mid-IR, surface features are visible.

Land Algorithm Description (2/3) : Surface Reflectance



- MODIS 250m and 500m data in 3 wavelengths ($\rho_{0.47\mu m}$, $\rho_{0.66\mu m}$, $\rho_{2.13\mu m}$)
- 2.13 µm identifies dark pixels and estimates surface at 0.47µm and 0.66µm: $\rho_{0.47\mu m} = \rho_{2.13\mu m}/4$; $\rho_{0.66\mu m} = \rho_{2.13\mu m}/2$
- Water/Shadows/snow are excluded

Land Algorithm Description (3/3) :

- Needs “dark” surfaces $\rho_{2.13\mu m} < 0.15$ and relatively strong spectral dependence of the path radiance.
- Dust and non-dust is determined by the spectral dependence of the path radiance at 0.44µm and 0.67µm
- Fine mode aerosol (bio-mass burning or pollution) is pre-determined from location & season. Coarse mode is fixed (Dynamical model)
- Land product (10kmx10km): $\tau_{a0.47}$, $\tau_{a0.66}$, $\tau_{a0.55}$
- $\Delta\tau = \pm 0.05 \pm 0.15\tau$